a conductive trace formed on the substrate and electrically connected to the raised portion of the contact.[; and]

[a substrate bondpad formed on the substrate and connected to the conductive trace for attaching a bond wire in electrical communication with the contact.]

73. (amended) The attachment member as claimed in claim 72 and wherein [the contact is formed as a bump and] the raised portion if formed as an asperity.

74. (amended) The attachment member as claimed in claim 72 and wherein [the contact is formed as a bump and] the raised portion is formed as a pointed projection.

77. (amended) The attachment member as claimed in claim 72 and wherein the substrate is formed of a ceramic material and the [contacts are bumps having asperities] raised portions are formed by a doinking process.

Remarks

The attorney for the applicants would like to thank Examiner Karlsen for the courtesies extended during the interview at the Patent Office on October 27, 1994.

By the Office Action, claims 45, 51-56 and 71-77 have been withdrawn from consideration. With respect to claims 72-77, the Office Action indicates that these claims will be rejoined upon an admission that this group of claims (Group IV) are not patentably distinct from claims 44 and 46-49 (Group I). It is admitted that the claims 72-77 (Group IV) are not patentably distinct from claims 44 and 46-49 (Group I). Rejoinder of claims 72-77 is therefore requested.

Claims 44 and 46-49 have been rejected under 35 USC §112, second paragraph, as being indefinite. These rejections are due to unclear recitations in defining the relationship of the claim elements. The limiting effect of

the force and penetration recitations on the scope of claim 44 is also stated to be unclear. In response to these rejections, claim 44 has been amended to more clearly recite the relationships of the claim elements. Independent claim 72 of the rejoined group of claims has been amended in a similar manner.

Specifically with regard to the §112 rejections, the contact is now recited to include a bump (e.g., 61 - Figure 5) and a raised portion (e.g., 69 - Figure 5). In addition, it is stated that penetration of the raised portion into the contact location on the die occurs "when the die and substrate are biased together in the testing apparatus with a predetermined biasing force". Antecedent basis for the term "biasing" is contained on page 21, line 17.

Claims 44 and 46-49 have been rejected under 35 USC §102 (b) over Littlebury et al. (U.S. Patent No. 5,177,438) or Liu et al. (U.S. Patent No. 5,177,439) or Kawade et al. (U.S. Patent No. 5,072,116) or Leedy (U.S. Patent No. 5,103,557). In response to these rejections, independent claim 44 has been amended. In addition, independent claim 72 of the rejoined group of claims has also been amended to distinguish from these same references.

The present invention is directed to an attachment member for establishing a temporary electrical connection with contact locations (e.g., bond pads) on a semiconductor die. The attachment member is adapted for use with a test apparatus for testing unpackaged dice. The attachment member includes a substrate formed of silicon (or other material) having a coefficient of thermal expansion that closely matches that of a semiconductor die. The attachment member also includes a contact structure that projects from the substrate. The contact structure includes raised portions for penetrating into the contact locations to a limited penetration depth. This contact structure is useful for testing the die using the bond pads formed on the die. These bond pads can be formed of a very thin layer (e.g., $\leq 1.5\mu m$)

of a metal such as aluminum. In the past it has been difficult to establish an ohmic connection with this type of thin metal bond pad without damage to the bond pad.

The §102 rejections are based on any one of the references of Littlebury et al., Liu et al., Kawade et al. or Leedy. It is submitted that there are numerous differences in both structure and function to the attachment member presently claimed in the amended claims.

With respect to the §102 rejections, the claims now state that the contact formed on the attachment member includes a "bump projecting from a surface of the substrate" and also includes "a raised portion projecting from a surface of the bump". It is also stated that the raised portion is "formed of a conductive material" and "formed and dimensioned" to "penetrate" the contact location as the substrate and die are "biased" together in the test apparatus. Furthermore, it is stated that the surface of the bump "abuts" the contact location on the die to limit penetration depth.

With regard to the Littlebury reference, the contact structure disclosed in this reference is not a piercing structure. As shown in Figure 2 of Littlebury, and described at column 2, line 28, the tip 19 of the contact 18 is adapted to "move across the bonding pad and scrub through the oxide layer". Furthermore, this is not a penetration limiting structure. The Littlebury contacts, as stated on column 4, line 25, are 100 microns high and 100 microns long. If this structure were allowed to pierce the bond pads of a die, there would be severe damage to both the bond pad and the die.

From the previous interview in this case, it is the Examiner's contention that the Littlebury contact could be construed as a bump with a raised portion as presently claimed. However, there is no penetration structure and no penetration limitation structure. The Littlebury contact is adapted to scrub away any oxide on the bond pad to establish

an electrical connection. The Littlebury contact is not "formed and dimensioned" for penetration. In fact, by teaching a scrubbing action, Littlebury teaches away from the presently claimed piercing structure. If one were to bias the Littlebury contact against a die in a test fixture there would be no penetration. If there was any penetration at all by the large square tip of the Littlebury contact, the bond pad would be damaged.

With respect to Liu, this reference is directed to a probe card for semiconductor dice that includes probe tips 41 formed on a semiconducting substrate 10. As with Littlebury, the probe tips 41 in Liu are not specifically formed to penetrate the bond pads on the die. It is merely stated that the probe tips 41 "contact" (see abstract) the pads on the die. There is no "raised portion" on a "raised bump" as presently claimed.

In addition, there is no penetration limitation structure or function taught by Liu. The probe tip 41 in Liu is formed as stated at column 5, line 29, by etching down "approximately fifteen micrometers". A probe tip 41 this high would extensively damage a flat bond pad which as previously stated, is sometimes formed as a thin metal layer approximately 1.5μm in thickness. Liu probe tips 41 are thus not "shaped and dimensioned" for limited penetration as presently claimed. Admittedly the surface of the substrate 10 would limit penetration if the contact force was high enough. However, the amended claims state that the "surface of the bump" and not the substrate abut the bond pad. Furthermore, Littlebury does not disclose or suggest such a penetration limiting function by the surface of the substrate. This would not be inherent because an extremely large biasing force would be required to effect this function.

With respect to the Kawade et al. reference, this is respectfully submitted to be non analogous art. The Kawade probe is for positional information measurement (column 1,

line 17). The Kawade probe is for measuring muscle activity current (column 1, line 13-14). Muscle is soft tissue and not a metal contact location on a die. This probe could not possibly be used to establish an ohmic connection for testing a semiconductor die.

As stated in re Clay 23 USPQ2d at 1058 (Fed. Cir. 1992), two criteria have evolved for determining whether prior art is analogous: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved. Under either of these criteria, Kawade is non analogous.

Furthermore Kawade does not disclose a bump with a penetration limiting surface. The only penetration limiting surface would be the surface of the substrate. A penetration limiting structure is not taught or suggested.

With respect to Leedy, this reference teaches probe tips formed on a flexible surface. In the embodiment illustrated in Figure 24, the probe tips 386-1, 386-2, 386-3 comprise a compressible material (col. 13, line 55) formed of several layers of flexible silicon dioxide or silicon nitride (col. 14, line 10) with a hard metal tip 388-1, 388-2, 388-3 (column 14, lines 11-16). As shown in Figure 25, the tips 388-1, 388-2 388-3 are pointed to pierce any oxide coating on a contact pad 294-1 but are not adapted to pierce the contact pad itself. Rather the probe tips 386-1, 386-2, 386-3 are adapted to flex so that the contact pad is not pierced.

With Leedy the penetration limitation is caused by flexure of the probe tips and not by "a shape and dimensioning" of the raised portions cooperating with a top surface of the contact bump. If the Leedy probe tips were to be biased against the die there would be no "abutting" of the surface of the probe tips because these members are not "formed and dimensioned" for abutment. Rather the probe tips are formed to be flexible. In fact, flexibility of the probe

tips is stated at column 2, line 15 of Leedy to be a key to the invention. Leedy thus teaches away from the presently claimed structure.

In view of the numerous differences between the attachment member presently claimed and the cited references, it is submitted that the claims define novel and unobvious subject matter. It is further submitted that in view of the amendments and arguments, the rejections have been overcome, and that claims 44, 46-49, 72-77 are now in a condition for allowance. Should any other issues remain it is requested that the Examiner contact the undersigned by telephone.

Respectfully submitted:

Stephen A. Gratton
Registration No. 28,418
Attorney for Applicant

10275 Gumbark Place
San Diego, CA 92131
Telephone: (619) 621-9045

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Stephen A. Gratton
Attorney for Applicant